

Rate Law Worksheet Side 1

1. For the reaction, $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 4 \text{NO}_2(\text{g}) + \text{O}_2(\text{g})$, the rate of formation of $\text{NO}_2(\text{g})$ is $4.0 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$.

- (a) Calculate the rate of disappearance of $\text{N}_2\text{O}_5(\text{g})$
- (b) Calculate the rate of appearance of $\text{O}_2(\text{g})$.

2. The reaction $2 \text{NO}(\text{g}) + 2 \text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$ is found experimentally to be second order in $\text{NO}(\text{g})$ and first-order in $\text{H}_2(\text{g})$.

- (a) Write the *rate law* for the reaction.
- (b) What is the overall order of the reaction?
- (c) What are the units for the rate constant k ?
- (d) If $[\text{NO}]$ is doubled (while keeping $[\text{H}_2]$ constant), by what factor will the reaction rate increase?
- (e) If $[\text{H}_2]$ is doubled (while keeping $[\text{NO}]$ constant), by what factor will the reaction rate increase?

RATE LAWS WORKSHEET (c o n ' t)

1. Consider the reaction: $2 \text{NO(g)} + \text{O}_2\text{(g)} \rightarrow 2 \text{NO}_2\text{(g)}$

The following data were obtained from three experiments using the method of initial rates:

	Initial [NO] mol L ⁻¹	Initial [O ₂] mol L ⁻¹	Initial rate NO mol L ⁻¹ s ⁻¹
Experiment 1	0.010	0.010	2.5×10^{-5}
Experiment 2	0.020	0.010	1.0×10^{-4}
Experiment 3	0.010	0.020	5.0×10^{-5}

- Determine the order of the reaction for each reactant.
- Write the rate equation for the reaction.
- Calculate the rate constant.
- Calculate the rate (in mol L⁻¹s⁻¹) at the instant when [NO] = 0.015 mol L⁻¹ and [O₂] = 0.0050 mol L⁻¹
- At the instant when NO is reacting at the rate of 1.0×10^{-4} mol L⁻¹s⁻¹, what is the rate at which O₂ is reacting and NO₂ is forming?

2. The reaction $2 \text{NO(g)} + 2 \text{H}_2\text{(g)} \rightarrow \text{N}_2\text{(g)} + 2 \text{H}_2\text{O(g)}$ was studied at 904 °C, and the data in the table were collected.

	Initial [NO] mol L ⁻¹	Initial [H ₂] mol L ⁻¹	Initial rate N ₂ mol L ⁻¹ s ⁻¹
Experiment 1	0.420	0.122	0.136
Experiment 2	0.210	0.122	0.0339
Experiment 3	0.210	0.244	0.0678
Experiment 4	0.105	0.488	0.0339

- Determine the order of the reaction for each reactant.
- Write the rate equation for the reaction.
- Calculate the rate constant at 904 °C.
- Find the rate of appearance of N₂ at the instant when [NO] = 0.350 M and [H₂] = 0.205 M.